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AN INVESTIGATION TO MONITOR THE CAKING AND COKING PROPERTIES OF A COAL SAMPLE FROM THE EMR LINGAN PILOT PLANT

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INTRODUCTION

This report investigates the caking, coking, and chemical properties of the first sample of coal received from cleaning 10 tons of Lingan coal in the EMR Lingan pilot plant.

The chemical analyses were conducted by the Fuels Research Centre and included the proximate analysis, total sulphur, and calorific value. These values appear in Table 1.

The sample was prepared for petrographic analysis according to ASTM Standard D-2797-72[1]. The maceral composition and mean maximum reflectance were determined according to ASTM Standards D-2798-72[2] and D-2799-72[3]. From the petrographic data the potential stability factor was calculated according to a modification of a method proposed by N. Schapiro and R.J. Gray[4]. The petrographic results are listed in Table 1.

The thermal rheological properties were characterized by the Gieseler plasticity, the Ruhr Dilatation and the Free Swelling Index.

Heads, Petrography and Laboratory Services, Coal Treatment, and Carbonization Operations Sections Respectively, Metals Reduction and Energy Centre, Mines Branch, Department of Energy, Mines and Resources, Ottawa, Canada.

In addition a wet screen analysis and a Soxhlet extraction were carried out on the coal sample.

The results are listed in Table 3. The screen analysis was conducted using a Shotts wet screening apparatus while toluene was used as the solvent in the Soxhlet extraction to determine the amount of oil remaining on the coal after the dewatering process.

The sample was carbonized in the Mines Branch 30 pound coke oven and the results are shown in Table 4.

TABLE 1

PETROGRAPHIC AND ALLIED DATA ON: Lingan Coal Cleaned at the EMR Lingan Pilot Plant

Project No. 03-3-1/15-7A Sample No. 2265-73 Pellet No. 479

I Petrographic Composition

Reactive Components

Distribution of Vitrinoid Types

Type	Percent
6	5.8
7	58.6
8	12.1
9	0.5

	%
Total Vitrinoid	77.0
Reactive Semi-fusinoid (1/3)	1.5
Exinoid + Resinoid	5.5
Total Reactive Components	84.0
Inert Components	
Inert Semi-fusinoid (2/3)	3.0
Micrinoid	7.7
Fusinoid	4.2
Mineral Matter	1.1
Total Inert Components	16.0

II Petrographic Indices

Mean Reflectance	0.76
Balance Index	0.70
Strength Index	2.79
Stability Index	27.0

III Chemical Analyses

Moisture .....%	2.6
Ash, db .....%	1.5
Volatile Matter, db .....%	34.5
Fixed Carbon, db .....%	64.0
Sulphur, db .....%	1.10
Btu, db ...../lb	14,910

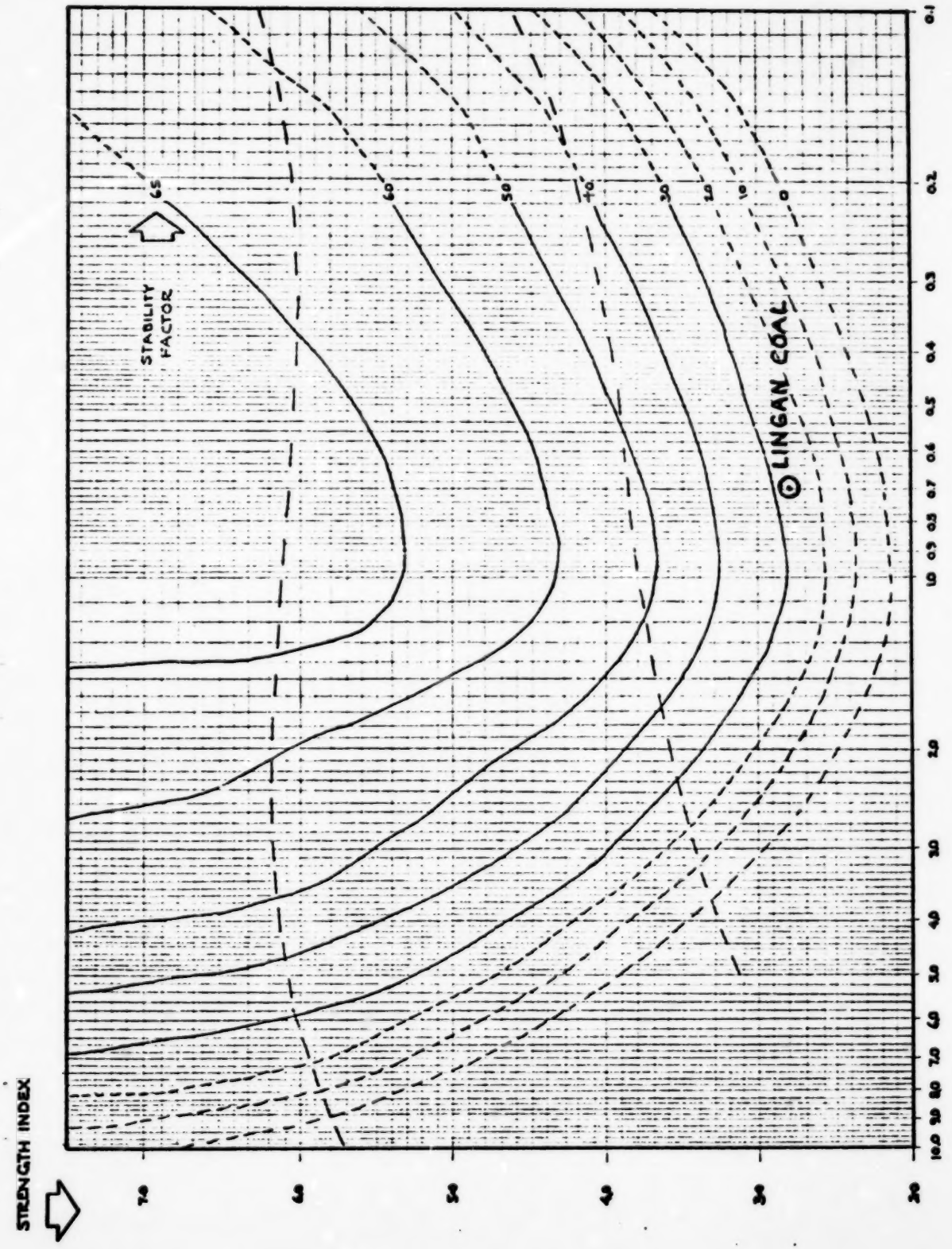

FIGURE 1 - Potential Stability Factor of a Sample of Cleaned Lingan Coal

TABLE 2 Thermal Rheological Properties of Component Coals

Identification	
Laboratory Number	2265-73
Description	Cleaned Lingan Coal
Linear Expansion	
Bd. 52 lb/ft^3 at 2% moisture...%	
Gieseler Plasticity	
Start .....°C	394
Fusion Temp. .....°C	410
Max. Fluid Temp. .....°C	438
Final Fluid Temp. .....°C	466
Solidification Temp. .....°C	473
Melting Range .....°C	72
Max. Fluidity .....dd/m	2050
Torque .....g.in.	40
Dilatation	
Ti - Softening Temp. .....°C	395
Tii - Max. Contraction Temp. °C	440
Tiii - Max. Dilatation Temp. .°C	464
Contraction .....%	31
Dilatation .....%	111
Free Swelling Index	
F.S.I.	7

TABLE 3 - Results of Wet Screen Analysis and Soxhlet Extraction

Identification

Laboratory Number 2265-73

Screen Analysis

Screen Size (Cdn. Std. Sieve)	Yield %	Cumulative %
+ 12	10.2	10.2
12 x 20	29.0	39.2
20 x 30	16.5	55.7
30 x 50	19.4	75.1
50 x 70	5.9	81.0
70 x 100	4.6	85.6
100 x 140	3.5	89.1
140 x 200	2.4	91.5
200 x 325	2.4	93.9
325 x 0	6.1	100.0

Soxhlet Extraction

Moisture Content	12.0%
Oil Content	Not Detectable

TABLE 4 - Carbonization Test in the Mines Branch 30 Pound Oven - Cleaned Lingan Coal

Test Identification Number.....	400
Date of Test.....	
Laboratory Number (refer for analysis of charge).....	2265-73
COMPONENT COALS IN CHARGE (% by wt. on db)	
Cleaned Lingan Sample	100%
CARBONIZATION DATA	
Net Weight of Charge (wet).....lb	33.78
Moisture in Charge.....%	2.7
ASTM Bulk Density (wet).....lb/ft^3	
Oven Bulk Density (db).....lb/ft^3	49.8
CARBONIZATION RESULTS	
Gross Coking Time.....hr:min	2:30
Maximum Wall Pressure.....lb/in^2	
Coke Yield Actual.....%	67.1
Mean Coke size.....in	1.45
Apparent Specific Gravity.....	
Screen Analysis of Coke (cumulative percentage retained on)	
3 inch sieve.....	
2 inch sieve.....	9.5
1 1/2 inch sieve.....	47.1
1 inch sieve.....	81.1
3/4 inch sieve.....	91.3
1/2 inch sieve.....	95.2
Percentage -1/2 inch (breeze).....	4.8
Tumbler Test (ASTM)	
Stability Factor.....	23.6
Hardness Factor.....	54.3
Japanese Tumbler Test (JIS) (cumulative percentage retained on)	
50 mm sieve.....	
25 mm sieve.....	
15 mm sieve.....	

OBSERVATIONS AND DISCUSSIONS

Ash Level

The ash value has been reduced by cleaning to 1.5 per cent.

Sulphur Content

The sulphur value of the cleaned coal is 1.10 per cent

Thermal Rheology of Component Coals

The plasticity, dilatation and F.S.I. values are lower than typical Number 26 Mine coal.

Petrography

The mean maximum reflectance value is 0.76 per cent which is lower than typical Harbour Seam coal. This value would indicate that the coal is hvBb in rank which is not verified by the volatile matter.

The high percentage of reactive components, 84 per cent, and low vitrinoid reflectance types results in a predicted stability factor of 27.0.

The average particle size of the pyrite crystal is reduced to less than 5 microns.

Extraction of Oil by Soxhlet Extraction

The amount of oil remaining on the coal, as determined by Soxhlet extraction, was not detectable although the smell of oil was noticeable from the coal.

Carbonization in the 30 Pound Oven

It is emphasized that, due to the small size of this oven, the results provide only an indication of the coking potential of the sample.

In this particular case it may be said that the results are far from encouraging. The stability parameter at 23.6 is very low, and the hardness value at 54.3 is also on the low side.

Generally speaking, it could be predicted that this coal would not satisfactorily act as a direct replacement for Devco 26 coal in a given blend.

ACKNOWLEDGEMENT

The authors are grateful to the Fuels Research Centre for the chemical analyses of the coal samples.

REFERENCES

1. ASTM Designation: D-2797-72, "Preparing Coal Samples for Microscopical Analyses by Reflected Light".

2. ASTM Designation: D-2798-72, "Determining Microscopically the Reflectance of the Organic Components in a Polished Specimen of Coal".

3. ASTM Designation: D-2799-72, "Microscopical Determination of Volume Per Cent of Physical Components of Coal".

4. N. Schapiro and R.J. Gray, "Petrographic Classification Applicable to Coals of All Ranks", Proc. Ill. Inst., 1960, 68, 83-97.

POOR

QUALITY

ORIGINAL